

A REVIEW

of the report

IMPORTANCE OF THE EASTERN ALASKAN BEAUFORT SEA TO FEEDING BOWHEAD WHALES, 1985-86

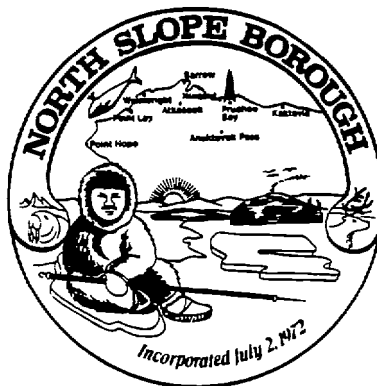
(Report of the U.S. Minerals Management Service
Sponsored OCS Study, MMS 87-0037)

REVIEW CONDUCTED BY

North Slope Borough
Science Advisory Committee

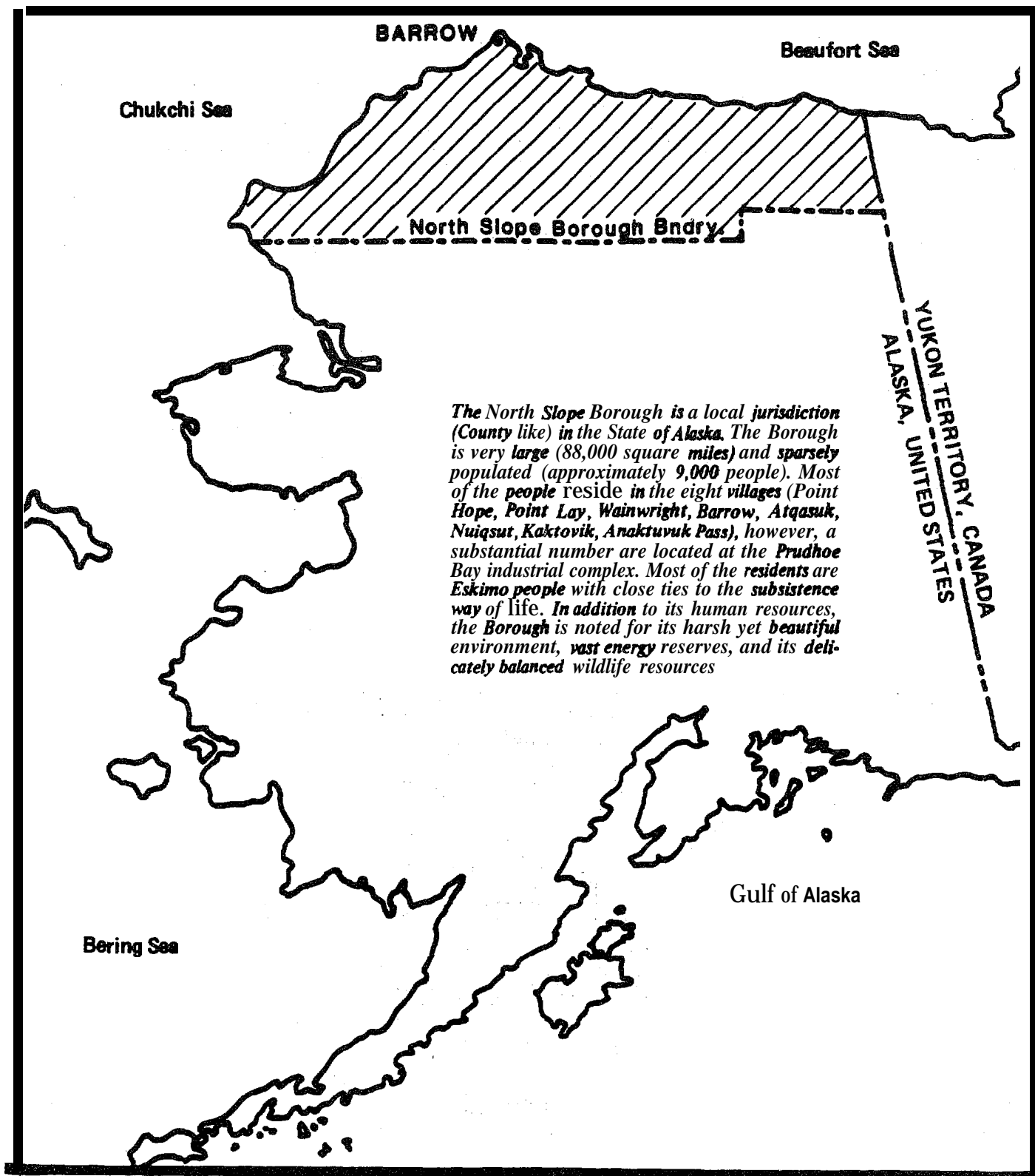
REVIEW REQUESTED BY

George N. Ahmaogak, Sr., Mayor
North Slope Borough
Box 69
Barrow, Alaska 99723



(NSB-SAC-OR-109)

December 1987



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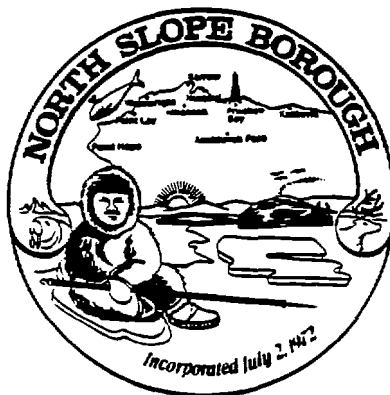
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Institute of Marine Science



UNIVERSITY OF ALASKA- FAIRBANKS
Fairbanks, Alaska 99775

7 December 1987

Honorable George N. Ahmaogak, Sr.
Mayor, North Slope Borough
Box 69
Barrow, Alaska 99723

File SAC-OR-109

Subject: Review of the U.S. Minerals Management Service Sponsored OCS Study Report (MMS 87-0037) on the **Importance** of the Eastern Alaskan **Beaufort** Sea to Feeding Bowhead Whales.

Dear Mayor Ahmaogak:

In response to your request of October 14, the Science Advisory Committee (SAC) of the North Slope Borough completed its task of reviewing the subject report. This task was accomplished by panel review and was supplemented by additional mail review. The panel conducted its business in the Globe Room of the Geophysical Institute, University of Alaska Fairbanks on November 23 and 24, 1987. Based on the results of the deliberations of the panel, a report was prepared and is transmitted to you.

I trust that this report will be satisfactory to your needs.

Sincerely,

A handwritten signature in cursive script, reading "John J. Kelley".

John J. Kelley
Associate Professor of Marine Science
Chairman, NSB Science Advisory Committee

cc: Dr. Thomas Albert

ACKNOWLEDGMENTS

The Science Advisory Committee is grateful for the many hours of effort devoted to arrangements for the panel review and preparations for publication of the final report. We wish to acknowledge particularly the assistance of Mrs. Helen Stockholm, Publications Department, Institute of Marine Science, Mauricette Nicpon, Genelle Tilton and Machelles Wells. Through their efforts, this report was produced on schedule.

INTRODUCTION

By request (Appendix 1) of the Mayor, North Slope Borough (NSB), the Science Advisory Committee (SAC) was asked to convene a portion of its membership along with invited experts to review the U.S. Minerals Management Service (MMS) sponsored OCS report (MMS 87-0037) on the Importance of the Eastern Alaskan **Beaufort** Seato Feeding Bowhead Whales, 1985-86.

Because of the interdisciplinary nature of this MMS study, the reviewers were chosen by the Chairman, SAC, from both the membership of the NSB/SAC and outside experts. Reviewers were selected on the basis of their recognized expertise in various aspects of this interdisciplinary review rather than on any particular institutional affiliation. The document (MMS 87-0037) was sent to all reviewers for peer review by mail. Some of the reviewers would participate in a panel review on November 23 and 24, 1987. A list of reviewers is presented in Appendix 2. A list of questions presented to guide the reviewers of the report is shown in Appendix 3.

A panel was convened on November 23 and 24, 1987 in the Globe Room of the Geophysical Institute, University of Alaska Fairbanks, Fairbanks, Alaska. Since it would be somewhat counterproductive for each panel participant to comment individually on each section, it was necessary to provide sufficient organization to the deliberations through the use of Review Group Coordinators (Appendix 4), offering sufficient time for comment from each participant.

The Review Group Coordinators, using the mail review submissions, provided a summary opinion and presented their summary on the first day of the panel meeting. During the second half of the first day, a rough draft opinion for all sections except Integration and Conclusions was prepared taking into account the comments of all of the panel members.

During the second day, the revised section reviews, except for Integration and Conclusions, were presented to the panel again and sent on for a final draft after conflicts, if any, were resolved. The last panel task was to review the sections on Integration and Conclusions. A draft final report of the panel proceedings was scheduled for delivery to the North Slope Borough during the first week in December and a final report for delivery prior to December 10, 1987. Appendices 5 and 6 present statements of SAC Review Policy and an overview of the Science Advisory Committee.

EXECUTIVE SUMMARY

The mayor of the North Slope Borough requested that the North Slope Borough Science Advisory Committee (SAC) undertake a review of the U.S. Minerals Management Service (MMS) sponsored Outer Continental Shelf report (MMS 87-0037) on the Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales, 1985-86. The Borough had strongly urged the MMS to conduct a feeding study, particularly in the area between Barter Island (Kaktovik) and the Canadian border, to ascertain the importance of this area to bowhead whales that are migrating and/or feeding there during the fall. Also, the final environmental impact statement for Beaufort Sea Lease Sale 97 presented the opinion that a drilling restriction (Stipulation #4) was no longer necessary. It was argued that other ways exist to provide needed protection for the bowhead whale. The North Slope Borough felt that this restriction provided added protection for the bowhead whales migrating or feeding in the area during the fall.

When the feeding report (MMS 87-0037) was released, the conclusions indicated that the area of concern was of much less importance than had been suspected by the North Slope Borough. Consequently, the NSB requested its Science Advisory Committee to conduct a review.

Because of the interdisciplinary nature of the report (MMS 87-0037), a panel review was deemed appropriate. Reviewers were chosen from the membership of the SAC and outside experts who possessed specific scientific and technical expertise which would be useful in providing the NSB with a thorough and fair assessment of the document.

Two days were allocated for the panel review. Therefore, it was necessary to distribute copies of the MMS (87-0037) report prior to the meeting for independent mail review. A set of guidelines was developed to bring about a measure of uniformity to the types of questions that each reviewer would address as they read the document. Review Group Coordinators (RGC) were selected from the panel to summarize the review comments on each section of the MMS report and to present this summary to the panel during the first day of the meeting. This method allowed each panel member to comment more effectively on the consolidated review of each section of the MMS report and its relationship to the evaluation of a null hypothesis presented as, "Food resources consumed in the Eastern Alaskan Beaufort Sea do not contribute significantly to the annual energy requirements of the Western Arctic bowhead stock."

The SAC review presents its opinion on each of the following sections of the report

- Water Mass Distributions
- Zooplankton and Hydroacoustics
- Bowhead Distribution, Numbers, and Activities
- Bowhead Whale Feeding Allocation of Regional Habitat Importance Based on Stable Isotope Abundances
- Energetic of Bowheads
- Movements of Bowhead Whales in the Beaufort Sea by Radio Telemetry
- Integration and Conclusions

WATER MASS DISTRIBUTIONS

One of the primary objectives of the MMS study was to examine the importance of upwelling of nutrient-rich water into the active surface layer from depth. Also, the importance of fronts and eddies to the concentration of zooplankton was recognized in the report. Objectives of the water mass distribution study were not explicitly stated. Also, the water mass study was not adequate to address the day-to-day and year-to-year variations which are recognized to be important to the overall objective of evaluating the null hypothesis.

The overall methodological design of the water mass distribution component of the MMS report and study are good. However, more intensive sampling would be required areally and on both ends of the study season to more effectively address small-scale features such as convergence zones, as they relate to zooplankton patchiness.

The presentation and discussion of the data in the water mass distributions section is adequate. The authors treated the data that were available very effectively.

In general, the time span (early-September 1985 and September/October 1986) of the ship-based observations of water mass distributions in the Eastern Alaskan Beaufort Sea was too short to conduct a study adequate to meet the criteria needed to address the null hypothesis.

ZOOPLANKTON AND HYDROACOUSTICS

The study objectives drove a research effort which produced results that must be viewed as applicable only to sampling seasons in early September 1985 and

September/October 1986. In this regard, the objectives for this study of zooplankton and hydroacoustics were probably not appropriate for the evaluation of the null hypothesis given present understandings of natural levels of variability (time and space) among pelagic populations and, in particular, interannual variations. The field program was very ambitious with limited sea time available in each of the two sampling seasons.

It was generally agreed that the choice of methods was appropriate. However, the general lack of a clearly identified, statistically structured sampling design is pointed out as a serious deficiency.

There was general agreement that most portions of the results section were clearly presented. Some specific shortcomings were identified. Comparisons between the two field seasons are compromised because the effort was unbalanced, with a limited (ice conditions) sampling effort in 1985. Restricting the acoustic sampling to only the upper 50 m (minus 2-7 m from the surface downward) eliminated roughly half of the study area (no deep water samples).

It was generally agreed that the interpretation and conclusions drawn from the data set represent a fair assessment of the study results.

The most obvious deficiencies were small sample size, short field seasons, apparent lack of a statistically supported sampling design, and a strong reliance on acoustically derived estimates of biomass that suffer from a number of untested assumptions associated with calibration and analysis. The results of this investigation apply to a short time period in which whale usage in the study area was low. If the objectives were meant to be predictive for future years, the present work must be considered inconclusive.

BOWHEAD DISTRIBUTION, NUMBERS AND ACTIVITIES

The objectives of this study were concise and clearly stated. In view of the general program objectives (pp. 3, MMS 87-0037), this section's objectives were also appropriate and would be important for the evaluation of the null hypothesis.

Standard and state-of-the-art methods were employed to conduct aerial surveys, make behavioral observations, measure underwater noise levels, undertake radio telemetry studies, and acquire data based on photogrammetry. Data resulting from surveys under unfavorable conditions during September 1985 are unsatisfactory for a variety of reasons and extrapolations based on these data would only compound the errors. Conclusions about the importance of the area were based, in

part, on unreliable estimates of bowhead whale use in 1985. Data from a single year are not adequate to judge the importance of the study area to the bowhead whale population.

The statement of results of this section has many components, some of which are less relevant to the study objectives than are others. The interpretation of data is uneven. A point in question is the 1985 data and the validity of presenting a specific number (4,200 whale days) of highly uncertain reliability that will subsequently be used by investigators as an acceptable and valid data point for future comparison. Also questionable is the reliability of strip-transect survey methodology to estimate whale densities under the circumstances encountered in the study area in 1986.

The interpretations and conclusions drawn from the data were mostly a fair representation of the results, with some notable exceptions. The year 1986 was probably one of low use rather than moderate use. There is probably over interpretation of the 1985 surveys. Whether the conclusions of this section contribute to the acceptance of the null hypothesis is questionable. The null hypothesis gives no indication of the threshold level of the term, "contribute significantly." The short duration and limited time effort of the project were also not adequate to address the null hypothesis.

There is a general deficiency which is not the fault of the investigators. That is, the study had a limited effective duration. It should have been conducted over several years.

BOWHEAD WHALE FEEDING

The project objective and sub-goals were clearly stated. Also, the project objective is appropriate to the overall objectives (pp. 3, MMS 87-0037) and test of the null hypothesis. A strictly empirical approach of surveying ^{13}C values for zooplankton and whales was undertaken. Since the completion of the five sub-goals was incomplete, so was the evidence for affirming or denying the null hypothesis.

The general method used in this study, isotope variations, has great potential to provide new insight into the ecology of whales. Overall, the technical methods used in the field and in the laboratory were excellent. The weakness of the study was in the design of the sampling plan. Overall, the scope of the isotope study was too narrow to allow a true test of the food site model.

The results presented in the figures and tables, as well as in the text, are clear and concise. It would have been useful to discuss the ^{13}C and ^{15}N data on baleen in

the context of mean values and variability among individuals and to compare to data on plankton and other animals in the study area.

Although the ^{13}C data on plankton do appear to show an east-west trend, there are too few data for the Bering and Chukchi Seas and Canadian waters. While the limited data set is highly suggestive of a two-site feeding pattern, the actual feeding sites are not firmly described by the ^{13}C and ^{15}N data. A more complex model is probably needed. The present model should not be used to support or deny the null hypothesis.

The scope of the empirical study was too narrow to measure basic parameters. The conclusions which the study support do not allow for the denial or affirmation of the null hypothesis.

ENERGETIC OF BOWHEADS

The objectives of this study are not clearly stated. The investigator states that the section relates to two of the overall study objectives. The apparent objective of determining the annual food requirements of the bowhead population as a whole is relevant to the null hypothesis if the estimate derived is reliable and can be compared to a reliable evaluation of how much food is obtained in the study area. In view of the overall objectives and statement of the null hypothesis, coupled with the sparse amount of available data, this section's objectives are unrealistic.

The efforts at estimating bowhead whale food requirements and feeding rates, though the investigator incorporated all available data, were severely limited by the lack of information on bowhead whales in particular, and large whales in general. The conclusions depend on few data and many assumptions that are not reliable for prediction or for testing the null hypothesis.

RADIO TELEMETRY

The four objectives of this radio tagging study of bowhead whales were clearly detailed and consistent with the overall project objectives.

Radio telemetry is a suitable method for meeting the objectives of this study. However, the approach taken was not well planned from the standpoint of radio frequencies, receiving equipment, power output of radio transmitters, field testing equipment, understanding of environmental and logistical constraints, and adequate planning for and implementation of a tracking procedure to establish and/or maintain contact with tagged whales. Five bowhead whales were tagged (in

1986), thus demonstrating that attachment of a transmitter to bowhead whales is feasible in late summer.

The sampling effort was inadequate to meet the objectives of the study. No whales were tagged in 1985. None of the objectives of the project were met. Many of the problems could have been overcome with proper planning and logistic support. Certain important questions regarding the bowhead whale can only be answered by following individual animals. Radio telemetry (including satellite technology) is the only suitable technique presently available to accomplish this task.

INTEGRATION AND CONCLUSIONS

Review of the section concentrated on how well the synthesis of the results of the previous sections met the overall objective of the study which was to evaluate the importance of the Alaskan Beaufort Sea as a feeding area for the Western Arctic population of the bowhead whale. Three of the study's objectives related to seasonal and spatial use patterns, availability of zooplankton, and the degree to which the prey consumption meets the annual food requirements. The fourth objective was most important to the outcome of this project. It required the acceptance or rejection of the null hypothesis stating that food resources consumed in the Eastern Alaskan Beaufort Sea do not contribute significantly to the annual energy requirements of the Western Arctic bowhead whale stock. In initiating this research, the contracting agency (MMS) held that the data sources listed in Table 1 (PP. 4, MMS 87-0037 report) would be sufficient to accept or reject the hypothesis. The conclusion to accept or reject this hypothesis would be used by the MMS to evaluate the impact of Outer Continental Shelf (OCS) development and assist in the development of mitigative measures whenever necessary.

Since the overall approach to the research on use of the Eastern Alaskan Beaufort Sea by bowhead whales is framed by the statement of a null hypothesis, the review committee found it necessary to examine this hypothesis.

The null hypothesis is sufficiently vague so as to allow rejection or acceptance without guidelines as to what constitutes significance. Nowhere in the document are the criterion required to reject the null hypothesis stated and, in fact, nowhere is the null hypothesis subjected to any statistical test.

"Significantly" is actually used in the sense of "biologically important," but what is "biologically important" is also undefined. It is left to the contractor (LGL Ecological Research Associates, Inc.) to decide what would represent a "significant

contribution" to the annual energy requirements of the Western Arctic bowhead whale stock. Whether the percentages of the annual energy requirements stated in the report do not "contribute significantly" is a value judgment which cannot be tested until rejection criteria are set.

The null hypothesis does not state a time frame over which the food resources in the study area are to be assessed. The implication is that the rejection or acceptance of the null hypothesis is time independent. It clearly is not. The importance of the Eastern Alaskan Beaufort Sea as a feeding area is a function of the size of the bowhead population, which may change over time; year-to-year variation in oceanographic conditions, plankton distribution and productivity; and whale distribution. The hypothesis which is sustained (cannot be rejected) in one year might be thoroughly refuted in another.

The investigators state that if the amount of zooplankton available to/or consumed by bowheads is small relative to the total annual population requirements, then the null hypothesis can be accepted. This statement is considered invalid because:

1. Certain whales or age/sex classes may derive substantial amounts of food from the study area.
2. The energetic value of the food maybe important if alternative sources are not available.
3. Even if the amount of food available and/or consumed was small during the years of the study, this does not mean that the whales could not consume a significant fraction of their energetic requirements from this area in other years.

The investigators report that, on the basis of their observations of biomass distributions and definitions of feeding thresholds, few areas support sufficient zooplankton stocks ($\geq 2 \text{ g/m}^3$) to allow for efficient feeding.

There are at least five reasons to suspect that the amounts of concentrated prey for whales are underestimated:

1. Forage is considered only in a portion of the upper 50 m of the water column (leaves out 50% of the study area).
2. "Filtered" acoustic data exclude the highest biomass values, even though this may be whale food.
3. The acoustic method employed cannot resolve patch concentrations smaller than 250 to 360 m in any dimension.
4. Zooplankton and other organisms occur as dynamic rather than static components within the system (i.e., patches form and reform in response to the physics of the system).

5. Net sampling underestimated the biomass of large mobile organisms such as euphausiids.

The integration of the MMS report depended upon an evaluation of the percentage utilization of the Eastern Alaskan Beaufort Sea as a feeding habitat for the Western Arctic bowhead whale stock. The investigators concluded that only a small portion ($< 2.0\%$) of the energy required to support the stock as a whole was obtained in the Eastern Alaskan Beaufort Sea. Clearly, there were problems counting whales and arriving at a whale density estimate. The available forage is, in all probability, underestimated. Therefore, this generalization is not accepted.

The focus in the subsection of the Integration Section addressed the importance of the Eastern Alaskan Beaufort Sea as an important feeding habitat for some smaller subset of the Western Arctic bowhead whale stock. The report points out that there is no evidence that whales spend more than 10 days feeding in the area, possibly stemming from a lack of observational data. The possibility remains that some bowheads may utilize the area for longer than 10 days. The importance of the region for an undetermined number of whales is left in doubt.

A preferential use (habitat partitioning) of nearshore areas by subadult whales may make those portions of the study area important to that cohort of the population.

The conclusion that small (subadult) bowhead whales feed extensively on *Limnocalanus* in nearshore waters and large whales feeding opportunistically on *Calanus* in offshore waters is contrary to records of stomach content observations of other observers. Subadult bowheads taken in other years had fed mostly on euphausiids and copepods, but not *Limnocalanus*. The assumption of *Limnocalanus* as the major prey species remains to be verified.

Euphausiids were not caught in significant quantities during zooplankton sampling, although they were a significant component of the content of bowhead stomachs. The densities of so-called non-zooplankton targets (and therefore automatically excluded in the MMS report) could well have been euphausiid and/or mysid populations near the bottom and in deeper water. If so, an additional important food source was under sampled in the report.

The Integration Section of the report concluded that the Western Arctic bowhead whale population acquired very little of its total annual food requirements from the Eastern Alaskan Beaufort Sea during late summer or autumn of 1985 and 1986.

What emerges from this research program is a compilation of related studies which in themselves contribute to a growing understanding of the environment of the Eastern Alaskan Beaufort Sea, but do not constitute an irrefutable evaluation of the importance of the region to the stock as a whole or to selected members of the population. The arithmetic exercises used to evaluate the importance of the study area ignore common statistical practice by applying a simplistic and linear approach to a very complex ecological problem. The overall conclusion of non-importance seems marginally reasonable only for the whale stock as a whole and only in the context of the sampling period within the 1985-86 feeding seasons.

The investigators conclude that the energy extracted from the study area is a small part of the annual energy requirement of the bowhead whale population and does not represent a significant contribution. In fact, in the judgment of the reviewers, the evidence presented fails to support rejection of the null hypothesis, but in no way does it sustain acceptance of it. In other words, the review committee does not accept the conclusion made by the investigators that the study area is unimportant as a feeding area for bowhead whales.

REVIEW OF THE REPORT SECTION ON WATER MASS DISTRIBUTIONS

OBJECTIVES

The objectives of this study section (pp. 11-133, MMS 87-0037), to gather information about physical oceanographic conditions and how they affect the local abundance of zooplankton, were not explicitly stated. One of the main objectives was to examine the importance of upwelling of nutrient-rich water into the active surface layer from depth. Also, the importance of fronts and eddies to the concentration of zooplankton is recognized in the report. The objectives of the physical studies were sufficient to meet the implied objectives of the water mass study. The water mass study objectives were not adequate to address the day-to-day and year-to-year variations which are recognized to be important to the overall objective of evaluating the null hypothesis.

METHODS

The investigators clearly recognized that the primary food source for the bowhead whale is affected by physical as well as biological processes (pp. 11, MMS 87-0037). Review of historical studies was effective. Based on the results of these historical studies it was recognized or re-emphasized that the zooplankton abundance in the study area should be highly variable both horizontally and vertically, which would affect the feeding areas of the bowhead whale, due to physical processes such as wind forcing, ice and resultant ice movement and turbulent mixing, etc. This wind-driven coastal upwelling system is highly dynamic.

The use of satellite data allowed for detection of the overall distribution of surface water temperatures and turbidity during the study period. Ground truth was provided, which is required to interpret the satellite data. However, the ship-based observations only involved temperature and salinity (T/S) measurements during the early September 1985 and the September/October 1986 sampling periods. This is a particularly short observation period, especially in relation to the length of time that the whales may occupy the Eastern Alaskan Beaufort Sea.

In 1985 the conductivity, temperature, and depth measurement instrument (CTD) was not calibrated in the field, which casts some doubt on the accuracy of the data. This was rectified in 1986. However, in this study the CTD did not measure temperatures below -0.35°C ; therefore, direct measurements of temperature were limited to values above -0.35°C . This inadequacy in temperature measurement

affected the salinity measurements, thereby requiring estimates of salinity and temperature employing the historical data. An appropriate CTD should have been used since historical data indicated the range of expected salinity and temperature in the study area.

Even though the number of ship-based T/S surface and profile observations were minimal, the information is probably sufficient to delineate the large-scale water mass distributions on the shelf during the main part of the study period. More intensive sampling, areally and on both ends of the study season, would be needed to more effectively address small scale physical features (such as convergence zones) as they may relate to zooplankton patchiness. The overall methodological design of the water mass distribution component of this report and study is very good.

RESULTS

Presentation and discussion of the data in the water mass section of the Eastern Alaskan Beaufort Sea report is adequate. Water masses are discussed from an historical perspective, and the data are supplemented with ship and remote sensing information. The report also recognizes that the oceanic regime is also affected by atmospheric and terrestrial processes. Overall, a description of the physical setting helps to set the conditions present in the Eastern Alaskan Beaufort Sea that may affect the concentration of zooplankton. The investigators treated the data that were available very effectively.

INTERPRETATION AND CONCLUSIONS

The investigators have treated the data interpretation and conclusions in a conservative manner. Their conclusions are well supported by the data.

STUDY LIMITATIONS

In general, the ship based observations of water mass distributions in the Eastern Alaskan Beaufort Sea were effective, considering the length of the observation period. However, the time span (early September 1985 and September/October, 1986) was too short to conduct a study adequate to meet the criteria needed to address the null hypothesis. This region exhibits large interannual summer ice cover variations, upwelling, and Bering Sea water intrusions. High day-to-day and year-to-year variability is the norm in this ice-impacted area. A more extended and extensive study would be needed to determine how these differences in circulation

patterns, water mass and ice effects influence the use of the region as a feeding site for bowhead whales. For example, additional information from moored current meters, turbidity meters and profiling shipboard current meters would significantly increase the knowledge of seasonal patterns of water circulation over the shelf. Utilization of satellite data from previous years when whales were abundant in the study area, such as 1982 (see tables of whale abundance on page 365 of the report), should be examined for surface patterns for comparison with years with few whales, such as 1985 and 1986.

Additional physical oceanographic data, especially subsurface, are needed to understand the physical characteristics of those zones important for the concentration of zooplankton. The study should also be extended seasonally. Much useful information relative to hydrography, biological productivity and water mass identification could be obtained from a more extensive examination of nutrient chemistry than was done in this study. Nutrient levels in the sea are useful in identifying areas of upwelling, as was done to a limited extent in this study, and in the description of primary and secondary productivity patterns.

REVIEW OF THE REPORT SECTION ON ZOOPLANKTON AND HYDROACOUSTICS

OBJECTIVES

The objectives stated in this section (pp. 135-256, MMS 87-0037) to guide the zooplankton and hydroacoustic studies were clearly stated and reasonable within the general goals of the larger project:

1. Determine the broad-scale horizontal and vertical distribution patterns of zooplankton biomass within the southern portion of the study area.
2. Determine the fine-scale characteristics of zooplankton near concentrations of feeding whales.
3. Determine the caloric content of major species and groups of zooplankton that comprise the diets of bowhead whales *vis* small and large copepods, mysids, euphausiids, etc.
4. Determine the physical and chemical characteristics of water masses (e.g., temperature, salinity and chlorophyll levels) that are believed to affect zooplankton distribution and abundance in the study area.

However, their appropriateness in the evaluation of the null hypothesis is probably not reasonable given present understandings of natural levels of variability (time and space) among pelagic populations. In this regard, the objectives drove a research effort that produced results that must be viewed as applicable only to the sampling seasons in early September of 1985 and September and October, 1986. Reservations expressed by reviewers concerned the ambitious nature of the field objectives given the size of the study area (25,000 km²) and the limited amount of sea time available for field work (25 days or fewer in each of two years).

METHODS

A variety of traditional and state-of-the-art methods were employed to address the study objectives. It was generally agreed that the choice of methods was appropriate.

However, in the case of net catching versus acoustic estimating procedures, questions were raised about the application of some portions of these particular methodologies, namely calibration techniques and the choice of balance between net tows and acoustic sampling. The choice to calibrate the acoustic system with net tows assumed that measures of volume scattering would be due solely to sonic returns from animal plankton populations. However, since the acoustic systems used

in this study are sensitive to macrozooplankton and everything larger as well, the correspondence is not expected to be 1:1. In fact, some very high acoustic returns and low catches led the investigators to “filter” the data, eliminating high unknown (but perhaps forage) biomass. Moreover, since euphausiids were rarely taken in the nets, but commonly occur in the stomach contents of harvested whales, there was concern about the ability of the nets used to catch these organisms. Low tow speeds and a policy of avoiding the near-bottom layer of the water column (depths 2-4 m above the sea bed) are identified as factors biasing the net catches away from these larger, faster species. This policy may have also resulted in missing deep, near-bottom layers of copepods. Since the estimates of biomass used to determine the total stock of whale food in the study area were scaled up from acoustic measures, these estimates are most likely low by an undetermined amount.

The general lack of a clearly identified statistically structured sampling design is pointed out as a serious problem of the overall methods section. Zooplankton populations are notorious for patchiness on a variety of time and space scales. In most distributional studies, at least the field sampling error is estimated from replicate sampling at selected locations. Instead, the investigators worried more about intra-calibration problems between the open bongo-net system and the opening-closing bongo-net, apparently assuming that the single samples at points along transects were representative of the biomass and abundance of natural populations. Unfortunately, without some replication, the error associated with these single measures is unknown.

RESULTS

There was general agreement that the results of most portions of this section were clearly and professionally presented. However, some specific problems were identified. The results of calibrating the acoustic system with net tows demonstrated that only 65% (1985) and 44% (1986) of the variability associated with measures of volume scattering could be explained by net catches. This means that acoustic estimates of biomass, calibrated by net tows, contain a high component of variance unexplained by the net catches alone. This is particularly a problem in 1986 where the correlation was poorest and the data set the largest. As previously mentioned, very high acoustic returns (thought to be fishes) were removed from the data set because of the lack of obvious correspondence with net catches. However, since euphausiids and small fishes are more active avoiders, their contribution to net-derived estimates of biomass was quite likely underestimated even though they

are potentially whale food. The review pointed out that the unfortunate choice of two quite similar (120 and 200 kHz), rather than different acoustic frequencies, eliminated the ability of the investigators to determine differences in returns from large (fishes) and small (zooplankton and micronekton) targets. The choice of a second frequency in the range 20 to 50 kHz would certainly have provided a more objective means to apply separation criteria to determine large and small target fields.

Limiting the acoustic information to only the upper 50 m (minus 2-7 m from the surface downward) eliminates roughly half of the study area. This was stated as a specific study objective (Objective 1) and means that a large part of the region was purposely ignored (depths below 50 m on all acoustic transects crossing the area to the 200-m isobath) in estimating potential whale forage. It is not clear from the report if the acoustic returns from deeper sections in the water column are available for analysis or were eliminated in the data storage procedure. Mention is made that the system was only quantitative to 100 m (presumably determined on the basis of power output, noise levels and the time-varied-gain amplification). These sampling limitations provided incomplete estimates of zooplankton forage available to whales by bathymetric region (Nearshore, Inner Shelf, Outer Shelf). Since these results (Table 16, pp 226, MMS 87-0037) are used in later manipulations of the data, this uncertainty is carried forward in the process of scaling the estimates upward to determine total amounts of zooplankton in the study area.

The sampling effort was unbalanced between the two field seasons, 1985 being constrained by weather and ice and a lack of observed whales feeding in the study area. Four equally spaced cross-shelf transects were sampled in 1986, but only two and part of a third, the first year. Some weathering-out is to be expected in the coastal Beaufort at this time of year. Unfortunately, in 1985 it reduced an already small data set to even fewer observations.

Stomach content analyses indicated that not all types of zooplankton are eaten by bowheads. Virtually all whale prey are crustaceans and there is no evidence that soft-bodied plankton are significant food sources. In order to facilitate comparisons of zooplankton biomass with whale food requirements data should be presented as total crustacean biomass in addition to total zooplankton biomass.

Despite these shortcomings, it was agreed that the work provided a substantial increase in our understanding of the distributional properties and caloric content of zooplankton taxa associated with water masses/types in the Eastern Alaskan Beaufort Sea.

INTERPRETATIONS AND CONCLUSIONS

It was generally agreed that the interpretations and conclusions drawn from the data set by the investigators are fair and represent an accurate paraphrase of the study results. This was particularly true for the qualitative rather than quantitative aspects of the investigation (community composition relative to bathymetric regimes, dominant species indicators of water mass/type environments, etc.). Conclusions concerning the caloric content of pelagic taxa arise from some of the first measurements made for zooplankters in the Alaska coastal Beaufort Sea. Descriptions of acoustically determined "zooplankton" patch size and biomass must be suspect since the acoustic system obviously saw more than was caught in nets, and because an unknown fraction of this biomass was eliminated by arbitrary "filtering" and restricting the data set to only portions of the upper 50 m of the water column. Thus the estimates of forage biomass are in all likelihood, conservative. They are also demonstratively quite variable (Table 16; pp. 226, MMS 87-0037). The biomass of zooplankton in areas where whales were observed feeding sometimes exceeded background biomass by about a factor of 10 (Figs. 84, 85, 86, 87 MMS 87-0037). It is not evident from the study results how and why these patches form.

STUDY LIMITATIONS

The most obvious deficiencies pointed out by reviewers were small sample size (131 net tows distributed between three towing strategies), short field seasons (25 days or fewer), only two autumns of study, apparent lack of a statistically supported sampling design, and strong reliance on acoustically derived estimates of biomass that suffer from a number of problems associated with calibration and analysis.

In terms of the objectives stated in this section (Zooplankton and Hydroacoustics), some significant progress was made. Information on species composition as a function of area, caloric content and general biomass distributions add to what is known about zooplankton in the Eastern Alaskan Beaufort Sea. However, the unspoken question concerning interannual variability cannot be addressed by the present small data set. Thus it must be recognized that the results of this investigation apply only to that 'snapshot' in time represented by the study, a time that whale usage was low in the area (pp. 365, MMS 87-0037). If the objectives of the zooplankton and hydroacoustic study were meant to be descriptive of this small window in time, it would seem they were conservatively addressed. However, if the objectives were meant to be predictive for longer seasons or representative for future years, the present work must be considered inconclusive.

REVIEW OF THE REPORT SECTION ON BOWHEAD DISTRIBUTION, NUMBERS, AND ACTIVITIES

OBJECTIVES

The objective of work reported in this section (pp. 257-368, MMS 87-0037) was to determine the extent and nature of utilization of the study area by feeding bowheads. This is a concise and clearly stated objective in line with general project Objectives 2 and 3, stated as follows:

- Objective 2. Estimate the number of bowhead whales utilizing the Eastern Alaskan Beaufort Sea as a feeding area during the summer and fall; observe and document their feeding activities, behavior and residence times.
- Objective 3. Estimate the degree of utilization of available food resources in the Eastern Alaskan Beaufort Sea by the Western Arctic bowhead whale stock.

These objectives were quite ambitious in view of a study area that encompassed 25,000 km². The study area was much larger than necessary to test the null hypothesis. Prior information indicated that feeding occurred mainly inside the 50-m contour, yet the official study area extended out to 2,000 m. This undoubtedly influenced the level of effort devoted to the area of main interest and may have affected the results as well.

In view of the general project objectives, the objectives of this section were appropriate. The information would be critical for evaluation of the null hypothesis.

METHODS

Standard and state-of-the-art methods were employed to conduct aerial surveys, make behavioral observations, measure underwater noise, undertake radio telemetry studies, and acquire data based on photogrammetry. Under favorable field conditions and with proper organization and preparation, the methods employed could reasonably have been expected to succeed.

The standard procedures of censusing bowhead whales from aircraft when extensive ice cover is present (as it was during the critical period after mid-September 1985) are less effective. Data resulting from surveys under unfavorable conditions are unsatisfactory for a variety of reasons and extrapolations based on those data compound errors. This is a critical point as conclusions about the importance of the study area were based in part on unreliable estimates of bowhead whale use in 1985.

The review group concluded that the census results obtained after mid-September 1985 (when bowheads started moving into the study area), and subsequent extrapolations based on those data, are not acceptable and should not be utilized. Conversely, results of the 1986 effort are good, reflecting appropriate methodologies and good field conditions.

The methods of making and recording behavioral observations were good and produced acceptable estimates of important parameters of detectability of bowheads in open water conditions.

Measurements of underwater noise were obtained using modern technological procedures.

Discussion of radio telemetry methodology is deferred to another review section.

This important section was not, in fact, based on results obtained in two successive and successful field seasons. The usable results generated by the investigators (not including data available from other sources) can only be based on estimates of whale numbers in the study area during the periods September 4 to 14, 1985 and September 2 to 27, 1986. Results of the 1985 field effort, though interesting and/or perhaps suggestive, are not an acceptable basis on which to derive a realistic estimate of bowhead presence in and use of the study area during late summer-early autumn.

Data from a single year certainly are not an adequate basis on which to judge the importance of the study area to the bowhead whale population. This is especially true in light of complementary data from other studies that suggest a high degree of interannual variability in physical and biological events in the Eastern Alaskan Beaufort Sea.

With the exception of the radio tagging effort, the review group found the methodological design of the study to be appropriate. The effectiveness with which the methodological design was carried out was largely limited by weather, ice conditions, mechanical difficulties, and other factors beyond the control of the investigators. Evaluated independently, each of the methods used could produce information relevant to the study objectives. However, the combination of approaches seemingly exceeded the constraints imposed by time and logistics.

RESULTS

This section has many components, some of which are less relevant to the study objectives than are others and interpretation of data is uneven.

As an example, the investigators developed a clear, straightforward and important procedure for estimating the detectability of bowheads through aerial survey procedures based on sightings and observations under open water conditions. The procedure is then applied equally to the questionable results of surveys made in poor conditions after mid-September 1985 and to the more reliable data obtained during 1986. A reviewer has no basis on which to evaluate the 'relative quality' of extrapolations from both years. For 1985, the investigators conclude that the equivalent of 4,200 whale days were spent in the study area compared to 13,000 whale days in 1986.

However, the 1985 data are subject to significant doubt based on conflicting statements in the section, as follows:

- p. 363,113, in. 1-3 "Results from this and other studies showed that few bowhead whales fed within the official study area at any time during the late summer or autumn of 1985."
- p. 363,113, in. 13-14 "In fact, at least a few whales did stop to feed in the study area in late September 1985."
- p. 364,11, in. 1-7 "Numerous bowheads were detected in Canadian waters during early-mid September of 1985 In Mackenzie Bay alone, several hundred bowheads were present in early September 1985. Some remained there well into October. . . . These whales presumably migrated through our study area under heavy ice conditions in late September or October 1985. Indeed, this was confirmed by photo identification in a few cases. . . ."
- p. 305,11, in. 1 "The estimates of densities and numbers of bowhead whales present in the study area in 1985 are very uncertain because of the low number of whales seen."
- p. 309,111, in. 3-4 "As noted earlier, the 1985 figure was probably underestimated because of the heavy ice. . . ."
- p. 309, ¶ 1, in. 9-11 "As a result, utilization of the study area by bowheads may have been more similar in 1986 and 1985 than is suggested by the whale-days figures."

That 1985 may have been, and probably was, a year of low whale abundance in and use of the study area is not the point in question. The point in question is the validity of presenting a specific number (4,200 whale days) of highly uncertain validity that will subsequently be used by the investigator- as an acceptable and valid data point for future comparison.

The investigators succeeded in producing additional information about the presence and activities of whales in the study area and confirmed that whales fed in the area in 1986. Many of those results are clearly presented.

We question the reliability of strip-transect survey methodology to estimate whale densities under the circumstances encountered in the study area in 1986. The clumped distribution of feeding aggregations of whales occurred in a narrow near-shore band and a stratified sampling approach should have been employed. The treatment of the whale density in the Kongakuk area is questionable. In this area, the individual counts of whales made during various aerial surveys seemed to equal or exceed the transect estimates of whale abundance. For example, survey results suggested that about 220-370 whales were present in the study area at various times in September 1986, though nearly 200 sightings are reported from the combined transect and search surveys. Also, 50 whales were estimated to have occupied the Kongakuk Delta region on September 1-6, even though the counts indicated 81 whales with no corrections for missed or submerged animals.

INTERPRETATIONS AND CONCLUSIONS

Reviewers were in agreement that the interpretations and conclusions drawn from the data were mostly a fair representation of the results, with some notable exceptions.

One such exception is the representation of 1986 as a fall of moderate whale use of the study area. The unnumbered table on page 365 (MMS 87-0037) suggests that for the period 1979 to 1986, based on bowheads seen per hour of survey effort (range = 0.0-11.3 sightings/hour), 1986 (2.4 sightings/hour) was probably a year of low use as opposed to moderate use. Abundance of whales in years of high use was 4-5 times greater than in 1986.

As previously indicated, relative to results of the 1985 surveys, there is over interpretation of available data.

The question of whether the conclusions of this chapter lend weight to acceptance of the null hypothesis is highly equivocal on several grounds. First, the null hypothesis gives no indication of the threshold level of the term "contribute significantly" and, second, the short duration and limited effort of the project were not adequate to address the null hypothesis.

The relative importance of the study area to specific cohorts of the bowhead population in the Eastern Alaskan Beaufort Sea requires additional consideration and comment. It was found that whales in the nearshore zone are primarily subadults, raising the possibility of differential significance of feeding areas to different cohorts

of whales. This point is immersed in discussions of energy requirements for the entire bowhead population.

STUDY LIMITATIONS

Given the reality of working in the study area, the only significant deficiencies of this study that were under the control of the investigators involved planning and execution of the radio tagging effort and over-reliance on 1985 census results.

There is a general deficiency which is not the fault of the investigators. That major deficiency is the limited duration of the study. If any meaningful effort to determine the importance of the Eastern Alaskan Beaufort Sea to bowhead whales is to be made, the primary component of this or a similar study should be conducted over several more years.

REVIEW OF THE REPORT SECTION ON BOWHEAD WHALE FEEDING: ALLOCATION OF REGIONAL HABITAT IMPORTANCE BASED ON STABLE ISOTOPE ABUNDANCES

OBJECTIVES

The central objective of this section (pp. 369-415, MMS87-0037) is to use stable isotope ratios as indicators of where bowhead whales feed in order to test the null hypothesis (pp. 3, MMS 87-0037).

The objective is broken down into five sub-goals which can be evaluated and commented upon individually.

1. Expand the geographic and seasonal data base on the isotopic composition of zooplankton in regions used by bowhead whales.

Comment: This task was completed in the sense that new and important data were acquired. However, as will be further discussed, not enough regions were sampled and not enough seasons were included to support the conclusions.

2. Determine the isotopic composition of bowhead whale tissue taken during the spring and fall hunts and compare these to determine whether there is evidence of appreciable feeding in winter.

Comment: A substantial data set was acquired, but it does not prove winter feeding.

3. Determine whether the isotopic variations along the length of bowhead baleen represent annual events and whether they are consistent within and between different baleen plates from the same animal.

Comment: The patterns within the same animal were shown to be consistent. Strong evidence was presented that the ^{13}C peaks in baleen are annual, but the evidence is not conclusive.

4. Document the isotopic content along the length of baleen from additional bowheads.

Comment: This was done. The large animals give excellent patterns, but the small animals do not seem to fit a simple model of annual growth.

5. Evaluate regional habitat dependencies of bowhead whales based on the isotopic composition of their prey, their baleen and their other tissues.

Comment: Strong suggestive data was presented for regional trends, but the data are too few to be anything more than suggestive at this time.

The reviewers felt that the project objective and sub-goals were clearly stated. Certainly the objective is appropriate to the general objectives and null hypothesis of the MMS/OCS (87-0037) study as stated on page 3 of the report. If sub-goal 5 had been fully met, then considerable insight into the importance of the Eastern Alaskan Beaufort Sea as a feeding site for bowhead whales would have been provided.

There are other objectives which should have been part of this research project. These relate to learning the fundamental reasons why zooplankton have different ^{13}C contents. Most workers in the field of isotope-ecology would agree that zooplankton reflect the ^{13}C value of their food, the phytoplankton. In turn, the phytoplankton reflect the ^{13}C content of theseawaterinorganic carbon (bicarbonate) and the isotope fractionation in photosynthesis. Thus, the fundamental question is what are the values for these two quantities over the complete range of the bowhead whale. Unfortunately, the study objectives made no mention of these fundamentals. Instead, a strictly empirical approach of surveying ^{13}C values of zooplankton and whales was undertaken.

Nevertheless, had the five sub-goals been reached, even the empirical approach would have lent great strength to affirming or denying the null hypothesis.

METHODS

The general method used in this study, isotope variations, has great potential to provide new insight into the ecology of whales. In order to discuss the strengths and weaknesses of the method, it is worthwhile to consider the conceptual model which is the core of the study.

Isotope workers generally accept the statement that "with regard to ^{13}C content you are what you eat to approximately ± 1 per mil" (i.e., ± 1 part per thousand). Thus, whales will reflect their diet to ± 1 per mil. The study seeks to demonstrate that zooplankton (whale feed) in the Canadian waters (-26) are several parts per mil different from zooplankton in the North Bering Sea (-20). These two extremes are called the end members. If it can be shown that the whales do not reflect the ^{13}C value of zooplankton from a certain area, such as the study area, then that area can be said to be insignificant as a feeding site. Clearly this requires a large set of ^{13}C data for zooplankton.

The ^{13}C content of whale tissues were sought by two methods. First, the ^{13}C values of soft tissue for northbound (spring) and southbound (fall) whales were measured. This is satisfactory, but difficult. It only applies to one growing season. Second, the ^{13}C content of baleen was studied because it records some aspects of the past feeding history of whales and it was suspected of showing annual patterns. These patterns might give information on winter and summer feeding.

The various measurements of ^{13}C of zooplankton and whale tissue were the correct methods to test the model. Unfortunately, the time and space limitations of

sampling of zooplankton were too severe to permit an adequate data base. The sampling effort within the stated narrow study area was adequate. However, the full power of the isotope method was not used because the end-members (Bering Sea and Canadian Beaufort), which are outside the narrow study area, were not adequately sampled. Such sampling is not complex, but does require detailed planning.

It should be noted that the sampling that was done in the study area was adequate, not limited by weather or equipment failure.

The investigators made a number of excellent observations and added to our knowledge of isotope chemistry. Overall, the technical methods used in the field and in the laboratory were excellent. The weakness of the study was in the design of the sampling plan:

1. Zooplankton from all potential feeding areas were not sampled.
2. Isotope studies of dissolved inorganic carbon (bicarbonate) and phytoplankton were not measured so that mechanisms could be discovered.

RESULTS

The results presented in the figures and tables as well as in the text are clear and concise. The large data base of ^{13}C baleen measurements were presented as plots of ^{13}C vs length of baleen. This is fine for some purposes, however, it would have been useful to discuss the ^{13}C and ^{15}N data on baleen in the context of mean values and variability among individuals. This could have been compared to data on plankton and other animals from the study area. The soft tissue is the other source of ^{13}C and ^{15}N data (Table 55, pp. 395, MMS 87-0037). Some simple statistical tests of this should have been applied.

INTERPRETATIONS AND CONCLUSIONS

Zooplankton Studies

The ^{13}C data on plankton (Table 54, pp., 382 MMS 87-0037) do appear to show an east-west trend. However, too few data are given for the Bering and Chukchi Seas and for the Canadian waters. A single ^{13}C value for North Bering Sea zooplankton is given and none for the Chukchi. Although sample collecting procedures for this area and for the Central and Eastern Arctic were described, no data were given. Perhaps it will be forthcoming. Perhaps more serious in the long run is the failure to plan to collect water for ^{13}C -bicarbonate measurements.

Feeding Sites and ^{13}C

All of the interpretations based on ^{13}C data which relate to the two end member feeding sites model (Canadian Beaufort and Bering Sea) are consistent with the data on whale muscle (Table 55, pp. 395, MMS 87-0037). The nine whales sampled in the spring had muscle ^{13}C values of -19 ± 1 . These are good data. However, of the three autumn whales, two had values of -21.4 but one was -19.2 . Thus, the spring data are consistent with an 'unknown' winter feeding site, but the autumn data are too few and inconsistent.

One must conclude that, while the limited data set is highly suggestive of a two-site feeding pattern, the actual feeding sites are not firmly described by the ^{13}C and ^{15}N data. In fact, a more complex model will probably be needed. One in which the known migration paths of whales are combined with isotope data to provide insight into feeding sites.

Overall, it is concluded by the reviewers that the scope of the isotope study was too narrow to allow a true test of the food site model.

The validity of the two feeding sites model is interesting but unproven. It is certainly only a qualitative model at this point and should not be used to support or deny the null hypothesis.

Study Limitations

There are important deficiencies in the study as it was designed. The design was too limited in the time and space sample grid to test the general model of multiple feeding sites. Further, the scope of the study was too narrow to measure basic parameters. Thus, an essentially empirical study with too few data points was carried out. The conclusions which the study support do not allow one to deny or assert the null hypothesis.

REVIEW OF THE REPORT SECTION ON ENERGETIC OF BOWHEADS

Unlike other sections of the report, this section (pp. 417-448, MMS 87-0037) was not subdivided into portions describing objectives, methods, results, and conclusions. Rather, there is an introduction followed by a discussion of whale energetic and a section presenting numerical conclusions about bowhead whale food requirements.

The objectives of this section are not clearly stated, rather the investigator merely states that the section relates to two of the overall study objectives. The apparent objective of determining the annual food requirements of the bowhead population as a whole is relevant to the null hypothesis only if the estimate derived is reliable and can be compared to a reliable estimate of how much food is obtained in the study area. In view of the general objectives, null hypothesis and the amount of data available with which to address the subject, this section's objectives are unrealistic.

The methods used to calculate energetic requirements of bowheads are briefly and inadequately described. It is implied that five approaches are used to estimate energy requirements of bowheads. However, only one approach was used to make a complete estimate of energy requirements, while the other four approaches were used to corroborate parts of this estimate. It should have been clearly stated that the estimation is based on the respiration method with the addition of specific energetic costs for growth, pregnancy, and lactation. An equation or a figure should have been given to show the required data inputs and their interrelationships.

The description of methodology used to calculate feeding rates is adequate.

The presentation of results of the study is mixed with the description of methodologies and discussion. The results are presented in a very confusing fashion. The investigator should have presented the equations that were used in the chosen methodology and described the data and assumptions required in each component of the equation. Sections that deal with alternative calculations that were used for comparison should have been kept separate and presented after complete calculations based on the primary method.

The conclusions based on this section depend on so few data and so many assumptions that they cannot be considered reliable and should not be used to make evaluations or predictions regarding bowhead whale feeding, or to test the null hypothesis.

These efforts at estimating bowhead whale food requirements and feeding rates were severely limited by the lack of information on bowhead whales in particular

and large whales in general. The investigator often fails to point out the severity of data limitations and the extent of assumption and extrapolation required to allow the calculations to be made.

The first series of calculations produced an estimate of the annual energetic requirements of the bowhead whale population as a whole. This was done by the respiration method with the addition of energetic costs for growth, pregnancy and lactation. The following are the major data requirements with a brief discussion of the adequacy and validity of the data used:

1. Length and sex/age structure of the population - This is based on the length frequency distribution from photogrammetric studies conducted in the Eastern Alaskan Beaufort Sea in summer 1982. Segregation by size on the summering grounds has been clearly documented which complicates assessment of the length composition of the population. The appropriateness of using the 1982 size-frequency sample is therefore questionable. The assumptions used regarding age/sex composition are based on fragmentary life history information. All whales longer than 13 m are assumed mature and the sex ratio of mature animals is assumed to be 1:1. A 3-year reproductive cycle is assumed for mature females.
2. Length-weight relationship for bowheads - Measurements of lengths and widths of bowheads taken from calibrated aerial photographs are used to estimate whale volume. Weights are calculated from volumes based on an assumed density of 1 kg/l. The total weight of one n-m long bowhead has been determined by weighing of pieces.¹ The weight obtained (14,797 kg) does not compare favorably with the estimate for an 1 l-m animal derived from the predictive equation used in this report (25,460 kg). More direct measurements of bowhead weights are needed before this important relationship can be established.
3. Blow rate - The number of blows per minute was calculated from visual observations of respiratory patterns of whales. These values are biased upwards because longer dives are less likely to be measured than short dives. Mean rates derived from the data are applied uniformly to all whales regardless of age, sex, or reproductive status. Since there are no data on blow rates during winter, values determined during the fall migration are used.
4. Lung capacity in relation to whale weight - The data from bowheads that are available to address this parameter are measurements of one collapsed lung from each of five known length whales, and the weight of the other lung from one of those whales. Lung capacity is then extrapolated from lung weight based on data from blue and fin whales.
5. Vital capacity - It is assumed that the volume of air taken in with each breath is 80% of the total lung capacity. No reference is given for this assumption.

¹ J. C. George, L. M. Philo, G. M. Carroll, T. F. Albert, 1987. 1987 Subsistence harvest of bowhead whales, *Balaena mysticetus*, by Alaskan Eskimos. Document SC/39/PS12 submitted at the 1987 meeting of the Scientific Committee of the International Whaling Commission.

6. Oxygen utilization - It is assumed that 10% of the inspired air is utilized as oxygen. No reference is given for this assumption.
7. Energetic costs of growth, pregnancy and lactation - Estimates of these costs are all based on length-weight relationships and assumptions regarding blubber thickness (assumed to be 15 cm in neonates and 25 cm in all other age/sex classes). The energetic costs of producing this tissue are calculated based on caloric density of sei and fin whale muscle (range 1500-2600 Kcal/kg) and blubber (range 3700-7000 Kcal/kg).

The investigator, does not attempt to put confidence limits on the estimate of population energetic requirements. However, it is obvious that if confidence limits were calculated, they would be very broad. As examples, the weights of whales may have been greatly overestimated, the assumed caloric values of tissues have a wide range (and may not be applicable to bowheads), and the relationship between lung capacity and whale size is virtually unknown although it is a central factor in the calculations.

The second set of calculations produces an estimate of the feeding rate of bowheads which is then used to estimate the concentrations of prey that are required for efficient feeding. The data used to make the calculations are as follows:

1. Distance traveled per dive - This was determined from the locations of dives and surfacings of whales that appeared to be feeding. Measurements excluded vertical travel and assumed only straight line movements. Stomach contents indicate that bowheads frequently dive to the bottom while feeding, and other species such as right whales have been observed to swim in circles while feeding in order to stay within a patch of prey. In actuality, the distances traveled by bowheads on feeding dives are unknown but are surely greater than the straight line distances used in calculations.
2. Hours of feeding per day - There are no data for this parameter. Values of 12 and 16 hours are used for illustrative purposes.
3. Cross-sectional areas of the mouth - The size of the mouth opening was calculated based on measurements of baleen from harvested whales and the open mouths of whales in aerial photographs.
4. Zooplankton biomass - Zooplankton biomass is based on samples collected in the study area in 1985 and 1986. These data are biased because samples did not cover the entire water column and fast-swimming organisms such as euphausiids were under sampled. The estimates cannot be considered reliable because most of the required data are not available. Moreover, where energetic parameters are derived from several independent estimates (e.g., filtering rate = mouth cross sectional area x rate of swimming x filtering efficiency) the error or uncertainty associated with each of the estimates contributes to the uncertainty of the derived estimate. In the above example, they combine multiplicatively. As a result, confidence intervals around the final estimates would be, in most cases, enormous (the error may exceed the estimate itself). Unfortunately, confidence intervals are never constructed; only the estimates themselves are used in evaluating the null hypothesis.

Throughout this section, the investigator fails to point out what data were used in the conclusions arrived at in other referenced studies. This has the effect of implying that confidence can be placed in information where that may not be the case. For example, the data in Lockyer (1981, pp. 417, MMS 87-0037) which are used to model the relationship between lung capacity and whale weight is actually the measured lung volume from two fin whales of known length. Similarly, the statement that the Kleiber equation "is also applicable to marine mammals (Lavigne *et al.*, 1986, pp. 417, MMS 87-0037)" is very misleading. The largest animal included in the data set used in that paper weighed about 5,000 kg, which is far smaller than the 24,900 kg estimated average weight of the smallest independent feeding bowheads. There is no evidence that large whales conform to Kleiber's equation.

This section fails to address the possible effects of reduction in available energy resources or increased energetic costs on individual bowhead whales and on the population. An understanding of these possible energetic impacts on bowheads is necessary in order to address the null hypothesis.

In summary, this section is not well organized and not sufficiently critical of the data and assumptions used. Because of the severe data limitations and unjustifiable assumptions, the conclusions derived from the calculations are not reliable.

REVIEW OF THE REPORT SECTION ON MOVEMENTS OF BOWHEAD WHALES IN THE BEAUFORT SEA BY RADIO TELEMETRY

OBJECTIVES

The objectives of the radio tagging study (pp. 527-547, MMS 87-0037) of bowhead whales were clearly stated as follows:

1. To determine residence times of bowheads in the study area.
2. To determine feeding rates of bowheads in the study area. -
3. To determine night behavior of bowheads in the study area.
4. To determine surfacing patterns of bowheads in the study area.

The objectives of the tagging study are judged to be consistent with the overall project objectives and could contribute to acceptance/rejection of the null hypothesis. An additional objective should have been, "Can bowhead whales be successfully tagged and tracked with the devices and equipment chosen?" This would not have been consistent with the project objectives of obtaining information on the ecology of the bowhead whale, but would have been appropriate given the manner in which the project was undertaken.

METHODS

In general, the method of radio telemetry is suitable for meeting the objectives of the study, even recognizing the difficulty of successfully tagging and tracking large whales. However, the approach taken on this particular project was ill-planned. The radio tagging effort suffered severely from: inadequate planning involving the selection of radio frequencies, receiving equipment, and power selection for radio transmitters; inadequate and sometimes inappropriate testing of equipment, including a belated test half way through the second field season; inadequate understanding of the environment and the logistic planning necessary to conduct a study on the north coast of Alaska/Canada; and failure to adequately plan for and implement a tracking procedure to establish and/or maintain contact with tagged whales.

A two-season study would have contributed greatly to information required on the residence time and behavior of bowhead whales in the study area had a sufficient number of whales been tagged and significant efforts made to maintain contact with the tagged whales. Five whales were tagged and signals were detected from only

four. The time in the field to conduct this study was not adequate in either 1985 nor in 1986 in view of the whales' known traditional migratory habits.

Other methods of determining bowhead whale presence and behavior were being conducted in other elements of this project and included aerial surveys and photogrammetry. Radio telemetry, however, would have been a significant supplement to these other techniques because individually marked whales could have been followed for the life span of the radio tag.

The methodological design of the study and its implementation in the field was poor. A positive note, however, is that five bowhead whales were tagged, thus showing that application of a transmitter to bowhead whales is feasible in late summer.

RESULTS

The results of the study are clearly presented. The sampling effort was inadequate to meet the objectives of the study. No whales were tagged in 1985 and only five were tagged in 1986. Only 37 hours over a period of eight days were spent searching for, tagging and monitoring whales. Of five whales tagged, one was never detected after tagging, three were detected several days (one at 16 days) after tagging but only once each, and one was tracked for one and one-half hours following tagging but not again thereafter.

Weather and technical problems plagued the project, especially during 1985, but a longer field season and more appropriate planning perhaps could have improved the project's success. What little data were collected were adequately analyzed.

In summary, none of the objectives of this project were met. Had better planning been incorporated into this study, surely more data would have been collected, thus at least partly meeting the overall project's objectives. Some of the more significant findings could have been:

1. How long do bowheads remain within the study area and what particular areas are being used? This could have helped to direct the sampling efforts of the zooplankton project, perhaps by even following and identifying the feeding sites of individual whales for extended periods. Also, it could have helped to establish a sampling stratification scheme for the aerial transect survey.
2. Over what period of time do individual bowheads feed relative to a 24-hour day and during the period of time spent in the study area? Such data could have provided useful input into the Energetic Section of this report where feeding times and rates are estimated, yet used to form major conclusions.

3. What are bowheads doing during periods of darkness? Essentially no information is available. Such data could have provided useful input to the Energetic Section.
4. The surfacing patterns of bowhead whales as determined for individual animals would have provided valuable information concerning metabolism. That too would have been useful to the Energetic Section of the overall project.

Radio telemetry, when used effectively, can provide this type of detail regarding the movements and behavior of individual animals. Yet the problems of tagging and tracking large whales in a difficult environment are enormous and perhaps the conclusion should be reached that the objectives of this section were too ambitious for this project. Many of the problems could have been overcome, however, with proper planning and logistic support.

INTERPRETATIONS AND CONCLUSIONS

A considerable amount of discussion is included concerning problems that were encountered in the course of this two-season study. Some of these are common knowledge to other investigators using radio telemetry. The investigators do not overstate the significance of the few data points collected.

STUDY LIMITATIONS

The study contained significant limitations in design, equipment selection, and logistic support. In order to meet the objectives of this study other projects should be undertaken that would not make similar mistakes and that would be adequately funded to provide the extensive logistic support necessary to successfully tag and relocate bowhead whales. Certain important questions regarding the bowhead whale can only be answered by following individual animals, and radio telemetry (including satellite technology) is the only suitable technique presently available to accomplish this task.

REVIEW OF THE REPORT SECTIONS ON INTEGRATION AND CONCLUSIONS

INTRODUCTION

Review of these sections (pp. 449-479 and pp. 481-485, MMS 87-0037] concentrated on how well the synthesis of the results of the previous study sections met the overall objective of the study to evaluate the importance of the Eastern Alaskan Beaufort Sea as a feeding area for the Western Arctic population of the bowhead whale. Specific objectives were specified by the Minerals Management Service (MMS). Three of these objectives required field surveys and literature searches to determine:

1. The seasonal and spatial patterns of utilization of the study area by bowhead whales, with emphasis on the identification of feeding areas.
2. The availability in those areas of the zooplankton on which bowheads feed.
3. The degree to which the prey acquired in the Eastern Alaskan Beaufort Sea meets the annual food requirements of individuals and of the population.

The fourth objective required acceptance or rejection of a null hypothesis stating that food resources consumed in the Eastern Alaskan Beaufort Sea do not contribute significantly to the annual energy requirements of the Western Arctic bowhead whale stock. In initiating this research, the contracting agency (MMS) held that the data sources listed in Table 1 (pp. 4, MMS 87-0037) would be sufficient to accept or reject the hypothesis. The conclusion to accept or reject this hypothesis would be used by the MMS to evaluate the significance of impacts of Outer Continental Shelf (OCS) development and assist in the development of mitigative measures whenever necessary.

Appropriateness of the Null Hypothesis

Since the overall approach to the research on use of the Eastern Alaskan Beaufort Sea by bowhead whales is framed by the statement of a null hypothesis, it is appropriate to examine this hypothesis.

The null hypothesis stated by MMS is sufficiently vague as to allow rejection or acceptance without guidelines as to what constitutes significance. At least two interpretations of the phrase, "contribute significantly" in the null hypothesis are possible. First, significance, in the statistical sense, means that the null hypothesis can be rejected with some explicitly stated level of confidence. Second, "significance"

may mean biological importance. Formulation of a null hypothesis, a construct from statistics, might imply the former interpretation of significance. In fact, this is not the case. Nowhere in the document is the criterion required to reject the null hypothesis stated and, in fact, nowhere is the null hypothesis subjected to any statistical test.

"Significantly" is actually used in the sense of 'biologically important'. But what is "biologically important" is also undefined. It is left entirely to the contractor to decide what would represent a "significant contribution" to the annual energy requirements of the Western Arctic bowhead whale stock. Whether the percentages of annual energy requirements estimated in MMS report 87-0037 do or do not "contribute significantly" is a value judgment which cannot be tested until rejection criteria are set. The real question is, 'What would be the consequence if the food resources of the Eastern Alaskan Beaufort Sea were no longer available to bowhead whales?' This question cannot be addressed from the data presented. Therefore, arbitrary judgments of "significance" have been made by the contractor.

Furthermore, the null hypothesis does not state a time frame over which the importance of food resources in the study area is to be assessed. The implication is that, with data collected in parts of two fall seasons, the rejection or acceptance of the null hypothesis is time independent. It clearly is not. The importance of the Eastern Alaskan Beaufort Sea as a feeding area is undoubtedly a function of the size of the bowhead population, which may change over time, and of year-to-year variation in oceanographic conditions, plankton distribution and productivity, and whale distribution. The hypothesis which is sustained (cannot be rejected) in one year might be thoroughly refuted in another.

¹The statement of a null hypothesis places the burden of proof on the alternative hypothesis; in this case, evidence must be presented showing significant use of the area in question for the null hypothesis to be rejected. The choice of the null hypothesis is based on the consequences of making a type I error (rejecting a null hypothesis that is true) and a type II error (accepting a false null hypothesis). The burden of proof is meant to control the likelihood of type I errors, making us more likely to accept a false null hypothesis than to reject a true one. The burden of proof must overcome inadequacies in sampling design, spotty historical data, and imprecision in the estimation of key parameters to a degree sufficient to reject the null hypothesis. Inadequacies in the data (particularly small sample sizes) will typically decrease the likelihood that the null hypothesis can be rejected. If the null hypothesis was stated in the form:

"Food resources consumed in the Eastern Alaskan Beaufort Sea do contribute significantly..."

then the burden of proof would fall in the opposite direction and inadequacies of the data would make it harder to disprove the null hypothesis that resources consumed in the area do contribute significantly. The conclusions of the study would, no doubt, differ. Simply stated, a weak data base increases the likelihood that the null hypothesis will be accepted.

ENERGETIC IMPORTANCE OF THE STUDY AREA TO BOWHEADS

The investigators state (pp. 449, MMS 87-0037) that, "[if] the amount of zooplankton available to and/or consumed by bowheads are small relative to total annual population requirements, then the null hypothesis could be accepted."

This statement is invalid for several reasons, including at least the following:

1. While the amount of food available and/or consumed maybe small in relation to food requirements of the population as a whole, certain individuals or age/sex classes may derive substantial amounts of food from the study area. This possibility is supported by data presented in the MMS report.
2. While the amount of food available and/or consumed maybe small, the energetic value of that food may be significant if alternative sources are not available and cannot be exploited in an energetically efficient manner.
3. Although the amount of food available and/or consumed may have been small during the years the study was conducted, it does not necessarily follow that whales could not consume a significant fraction of their energetic requirements from the study area in other years.

Zooplankton Available to Bowheads in the Study Area

In this section, acoustic measures of zooplankton stocks in portions of the upper 50 m of the water column are converted to area-wide estimates of zooplankton biomass (Table 67, pp. 450, MMS 87-0037) for the study area. By limiting the depth of measuring zooplankton stocks, the study ignored the possible contribution of deeper prey. The investigators assert that dense concentrations of biomass did not occur deeper than 50 m but this contradicts other earlier statements about offshore patches of potential food (i.e., conclusion number 13 in the Zooplankton and Hydro-acoustic Section, pp. 255, MMS 87-0037). In fact, since the entire water column was not examined for locations north of the 50-m contour (at least in this particular analysis), we can be assured that the biomass estimates of total available whale forage are in error by some undetermined amount. One must also remember that the acoustic measurements in 1986 were "adjusted" to filter out high values in biomass allegedly caused by fishes. What this means is that the highest measures of biomass and their spatial extent were not part of the data base. The unfortunate choice of two quite similar acoustic frequencies prevented any estimate of acoustically determined non-zooplankton biomass that might have helped to evaluate the magnitude of this omission.

Given these sources of uncertainty, estimates are nevertheless made of the total amounts of zooplankton in the study area during each of the two fall seasons. When the transect estimates were scaled up (Table 16, pp. 226, MMS 87-0037) to totals for

the entire shelf (Table 67, pp. 450, MMS 87-0037), the variability associated with the procedure was not reported. This is unfortunate, since the values presented were taken at face value and used to indicate the lack of significance of the area.

Reviewers recognized the difficulties of adequately sampling zooplankton, because of its patchy distribution. We were concerned about reference estimates of average zooplankton biomass and caloric value in the study area, when it is abundantly clear that the more dense patches are where the bowheads feed. Apparently, it is the frequency and distribution of dense biomass concentrations that are important for bowhead feeding. Documented interannual variations in wind patterns and ice certainly affect the distribution of dense zooplankton concentrations which occur. Thus, the study area no doubt varies in its importance to feeding bowheads from year to year.

Whales and other predators would not find adequate food in any ocean if the importance of an area was based on average abundances. The key to survival of bowheads, as properly indicated by the investigators, is the presence of zooplankton patches and the whales' ability to find and utilize them. Interpretation based on averages is one of the reasons why most models of oceanic systems do not give meaningful production transfers from primary to secondary trophic levels. The evaluation of the importance of the Eastern Alaskan Beaufort Sea as a feeding habitat is based on the determination of the amount of "sufficiently concentrated zooplankton" available at any one time. The investigators report that on the basis of their observations of biomass distributions and definitions of feeding thresholds, few areas support sufficient concentrations ($\geq 2 \text{ g/m}^3$) to allow for efficient feeding. While this may be a true reflection of the data base, a question remains about how representative it is of the region studied. Seven acoustic transects in two field seasons hardly seem adequate to address important questions of patch distribution and frequency.

There are at least five reasons to suspect that the zooplankton study underestimates the amounts of concentrated prey for whales. First, as previously stated, the analysis considers only forage in a portion of the upper 50 m of the water column on all transects. Second, the "filtered" data exclude the highest biomass values because they "were not catchable" by nets and therefore considered to be something other than whale food. Third, the acoustic survey could not resolve patch concentrations smaller than 250 to 360 m in any dimension. This means that the acoustic estimates averaged the biomass over these distances, integrating any small-scale patchiness in exactly the same way as did net tows. Fourth, zooplankton and

other organisms occur as dynamic rather than static components within the system. Their concentrations at any time depend upon supply rates to the study area, population growth rates and interactions with vertical and horizontal flow fields. The claim is made that only a tiny percentage of the total zooplankton stock over the shelf is aggregated at densities high enough to feed whales. This may have been true at the time the observations were made. This is not likely to represent the same degree of aggregation at other times. Fifth, direct sampling by nets admittedly underestimated the biomass of large mobile organisms such as euphausiids because of avoidance, and the fact that the nets were not fished close to the bottom.

In some instances, the investigators address these problems. However, no indication is given about the magnitude of factors contributing to underestimation of total whale food or its concentration. The matter is left unresolved by the investigators.

Zooplankton Consumption in the Study Area by the Bowhead Population

The synthesis in the MMS report rests on an evaluation of the percentage utilization of the Eastern Alaskan Beaufort Sea as a feeding habitat for the Western Arctic bowhead whale stock. On the basis of estimates of whale days used, food requirements, and available zooplankton, the investigators conclude that only a very small portion ($< 2.0\%$) of energy required to support the stock as a whole is obtained in the Eastern Alaskan Beaufort Sea.

Clearly there are problems counting whales and arriving at whale density estimates. As previously pointed out, the available forage was, in all probability, underestimated. Food requirements are based on a general model of metabolism and growth. Given the uncertainties associated with estimating each of these variables, it seems reasonable to cautiously conclude that a rather small percentage of late summer/early fall (1985 and 1986) energy requirements of the Western Arctic bowhead whale stocks were met by feeding in the study area. Whether this amount is significant or not, cannot be ascertained by the MMS study.

Zooplankton Consumption in the Study Area by Individual Bowheads

The focus in this section addresses the importance of the Eastern Alaskan Beaufort Sea as a critical feeding habitat for some smaller subset of the Western Arctic bowhead whale stock. The investigators point out that there is no evidence that whales spend more than 10 days feeding in the Eastern Alaskan Beaufort Sea.

This assertion probably stems more from the overall lack of observations than from reliable data. So the possibility remains that some bowheads may utilize the area for feeding longer than 10 days each year. Thus, the importance of the region for an undetermined number of whales is left in doubt. This reasonable doubt means that the null hypothesis being considered in the investigation applies only to the Western Arctic bowhead whale population as a whole, but probably not to a smaller subset of individuals.

Food Requirements

The food consumption in the study area, in comparison to that farther east, is certainly comparatively low for the population as a whole. However, the apparently preferential use (habitat partitioning) of nearshore areas by subadult whales may well make those portions of the study area important to that cohort of the population. It should be remembered that all whales landed at Kaktovik within a relatively short time of having been killed, had recently fed.

Bowhead Feeding areas in the Eastern Alaskan Beaufort Sea

Examinations of stomach contents of bowhead whales^{2,3,4} harvested at Kaktovik do not correspond well with results of zooplankton sampling. The scenario described in the report of small whales feeding extensively on *Limnocalanus* in nearshore waters and large whales feeding opportunistically on *Calanus* in offshore waters is contrary to stomach content observations.

Limnocalanus occurred in only 1 of 11 bowhead stomachs that have been quantitatively examined. That was a small whale (7.6 m long) taken on September 10, 1986. Although *Limnocalanus* comprised a substantial portion of the contents, large amounts of euphausiids and gammarid amphipods had also been consumed. The stomach contents of a second small whale (7.3 m long) taken on September 26, 1986 consisted of 96% euphausiids. These observations contradict the assumption in the report that small whales feeding east of Kaktovik were focusing their efforts on

² Lowry, L. F. and K. J. Frost. 1984. Foods and feeding of bowhead whales in western and northern Alaska. Sci. Res. Whales Res. Inst. 35:1-16.

³ Lowry, L. F., K. J. Frost, J. C. George and K. Coyle. 1987. Feeding ecology of bowhead whales: prey spectrum and seasonal and regional feeding patterns. Abstract. T6 In Abstr. 4th Conf. Biol. Bowhead Whale, 4-6 March 1987, Anchorage, Alaska. North Slope Borough, Barrow, Alaska.

⁴ Lowry, L. F. 1987. Unpublished data (personal communication).

Limnocalanus. Small whales taken in other years had fed mostly on euphausiids and copepods, but not on *Limnocalanus*.

Euphausiids were not caught in significant quantities during zooplankton sampling although they were a significant component of the contents of bowhead stomachs. Overall, euphausiids comprised about 28% of the stomach contents and provided more than 50% of the contents in three whales. Only 4 of 11 whales quantitatively examined had not consumed euphausiids prior to being taken. In contrast, the percent of total zooplankton biomass that consisted of euphausiids (based on net tows) ranged from 0 to 4.4%, with the former value obtained from sampling in whale feeding areas. The reviewers were of the opinion that high densities of so-called non-zooplankton (and therefore automatically excluded) targets could well have been euphausiid and/or mysid populations, particularly near bottom in the deeper water. If so, additional important food resources were under sampled in the region.

The results of zooplankton sampling lead the investigators to the assumption that *Limnocalanus* is the primary prey of whales feeding in shallow portions of the study area. A related assumption is that sampling and analysis of patches of *Limnocalanus* provides much significant data that can be used to address the issue of bowhead feeding ecology. Because *Limnocalanus* has not been a major prey in the stomachs of whales feeding in the area, the reviewers believe that these assumptions are presently unjustified.

Total Population Consumption

The Integration Section of the MMS report concludes that the Western Arctic bowhead population acquired very little of its total annual food requirements from the Eastern Alaskan Beaufort Sea during the late summer or autumn of 1985 or 1986. This conclusion is reached by each of two lines of argument: (1) consumption by the bowhead population and (2) consumption by individual whales. The conclusion draws upon data acquired during the study and historical information that was reported in previous sections of the MMS report which alone are rated favorably.

While the results of the various investigations strongly suggest that the Eastern Alaska Beaufort Sea study area played a minor role in feeding the Western Arctic bowhead whale stock during the limited sampling periods of autumn 1985 and 1986,

results of the research are not conclusive, nor should they be considered the definitive answer to this question.

What emerges from the research program is a compilation of related studies which in themselves contribute to a growing understanding of the Eastern Alaskan Beaufort Sea environment, but which do not constitute an irrefutable evaluation of the importance of the region to the stock as a whole or to selected members of the population. The arithmetic exercises used to evaluate the importance of the study area ignore common statistical practice by applying a grossly simplistic and linear approach to a very complex ecological problem. Given the multiplicative and/or additive nature of error associated with the kinds of data sets collected (distribution and abundance of whales and food), the calculated values of utilization, energy requirements, and food stocks of appropriate concentration must be viewed with great caution. These are, at best, first-order estimates with unknown error. They arise from a very restricted data base in time and space.

The investigators conclude that the energy (annual food requirements) extracted from the study area is a small part of the annual energy requirement of the bowhead whale population and does not represent a significant contribution. The question of defining "significance", however, remains unresolved. They then conclude that the null hypothesis should be accepted. In fact, in the judgment of the reviewers, the evidence presented fails to refute the null hypothesis, but in no way does it prove it. In other words, the review committee does not accept the conclusion made by the investigators that the study area is unimportant as a feeding area for bowhead whales.

NORTH SLOPE BOROUGH**OFFICE OF THE MAYOR**

P.O. Box 69
Barrow, Alaska 99723

Phone: 907-852-2611

George N. Ahmaogak, Sr., Mayor

October 14, 1987



Dr. John **Kelley**
Chairman
North Slope Borough Science
Advisory Committee
Institute of Marine Science
University of Alaska
Fairbanks, AK 99775

**SCIENCE ADVISORY COMMITTEE
NORTH SLOPE BOROUGH**

SAC-OR-109

Dear John,

As you know the federal government has recently made available the Final Environmental Impact Statement for Beaufort Sea **Lease** Sale 97. In that document is the opinion **that** a "seasonal drilling restriction (so **called** stipulation #4) is **no** longer necessary as they feel there are other ways to provide needed protection to the bowhead whale. Without this seasonal drilling restriction offshore drilling could **be** allowed during the **bowhead** migration. We view the seasonal drilling restriction as a means to provide added protection especially to bowhead whales in the Alaskan Beaufort Sea that are migrating and/or feeding during the fall. An area of particular concern in this regard is the feeding area between Barter Island and the Canadian border.

Regarding Sale 97 the State of **Alaska** still has the opportunity to comment on the Proposed Notice of Sale and the Borough has an opportunity to provide input to the State. Apparently the Minerals Management Service (**MMS**) has granted the State an extension as to the time when such comments must be received. This extension of the commenting period is due to the fact that two important research reports are just now becoming available (see attached copy of R. **Grogan's** letters of Sept. 30 and Oct. 1). One of these reports that became available within the past two weeks concerns the use by bowheads of the feeding area between Barter Island and the Canadian border. The second report which will probably become available in late November concerns bowhead **whales** and acoustic stimuli.

As you may remember the Borough was a major force involved in getting MMS to undertake the feeding study since **it** has long been our opinion that the area is important feeding habitat for bowhead whales. Apparently MMS personnel have indicated to

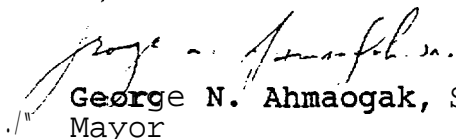
Dr. John Kelley
October 14, 1987
Page 2

Borough staff members that the recently released feeding study report shows that the area is of much **less** importance that we had suspected. In view of the great importance to us of properly assessing the significance of this area as feeding habitat for the bowhead whale I ask that you undertake a review by the Science Advisory Committee of the report "Importance of the Eastern Alaskan Beaufort Sea to Feeding Bowhead Whales, 1985-86" which was prepared for MMS. Although such a review should be concerned with many questions some of the more obvious include the following.

1. **Were** the study objectives well stated and appropriate to determining whether the waters between Barter Island and the Canadian border are important feeding habitat for the bowhead whale?
2. Were the utilized methodologies appropriate?
3. Was the area studied in sufficient detail and over a sufficient time period?
4. Are the report's findings clearly substantiated by the data presented?
5. Are there obvious information needs that remain in order to properly determine the importance of the area as bowhead feeding habitat?

As you move forward with the review of the **feeding study** report please remember that we will most likely need **your** findings by early December. I'm sure that you will wish to better define the questions to be posed to the reviewers and that you will want to also **develope** an **appropriate** list of additional **documents** for examination by-the rev-i-ewe-rs. In this regard I ask that you work with Dr. Tom Albert and anyone else that you feel is appropriate. I wish you and the other members of our Science Advisory Committee success in this important task.

Sincerely,


George N. Ahmaogak, Sr.
Mayor

Attachment (1)

cc: Dr. Tom Albert
Files

NORTH SLOPE BOROUGH
SCIENCE ADVISORY COMMITTEE

Reviewers: Minerals Management Service OCS Report 87-0037

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GUIDELINES FOR PREPARING THE REVIEW FOR EACH REPORT SECTION

OBJECTIVES

- . Are the objectives clearly stated
- Are the objectives appropriate in view of the general objectives and null hypothesis on page 3
- Are there other objectives that should have been stated

METHODS

- . Are the methods appropriate to reach the objectives
- . Was the 2-year time of the study long enough to conduct a proper study and reach the objectives
- . Was the sampling effort adequate
- . Was the time in the field long enough in view of the whales' migratory habits
- . Were there other methodologies that should have been used

RESULTS

- . Are the data clearly presented
- Was the sampling effort adequate during the field season
- . Did weather (ice, etc.) or mechanical problems (equipment, etc.) reduce the total amount of survey effort
- . Did weather or mechanical problems reduce the effectiveness of the survey effort that was done
- . Were the data properly analyzed

INTERPRETATIONS AND CONCLUSIONS

- . Are they consistent with the data
- . Are there "over" or "under" interpretations

STUDY LIMITATIONS

- . Are there significant deficiencies in the study
- Does anything more need to be done to reach the objectives



UNIVERSITY OF ALASKA-FAIRBANKS
Fairbanks, Alaska 99775

MEMORANDUM

TO: All Participants, NSB Science Advisory Committee Review
of the Minerals Management Service Report (MMS 87-0037)

FROM: John J. Kelley, Chairman, NSB/SAC *J. Kelley*

DATE: 9 November 1987

RE: Panel Meeting Schedule and Agenda

The objective of the panel meeting is to review the MMS 87-0037 OCS report and to deliver a written opinion to the chairman at the conclusion of the meeting. In order to accomplish this task I suggest that we adhere to the following schedule.

Monday, 23 November 1987

0800 Assemble in the Globe Room of the Geophysical Institute, University of Alaska Fairbanks. Coffee and donuts will be available.

0830 Plenary session.
Introduction - J. Kelley
Background - T. Albert
Charge to Committee - J. Kelley

0900- Noon Plenary session. A Review Group Coordinator (RGC) will present a brief review of a Report Section (RS) based upon whatever written or verbal comments have been obtained from members of the Review Group (RG). Twenty minutes will be allowed for this review of each section, including time for questions or discussion by the panel. It is recommended that the RGC allow 10 minutes for the summary and 10 minutes for questions.

The above procedure will be repeated for all seven sections (See Appendix 1 for the identification of the Review Group Coordinator and Report Section).

Noon -1330 Lunch. Arrangements have been made for the panel to have lunch in the Wood Center, Room 127A/B.

1330-1725 RG meetings. Each Review Group (see Appendix 2) will meet to consider plenary comments and to continue the review of the individual MMS/OCS Report Sections (RS). Separate meeting places will be provided for this purpose. It may be advisable for some Review Groups to meet jointly (e.g., Water Masses with Zooplankton/Hydroacoustics).

1725-1800 Plenary Session. Each RGC presents a status report of approximately 5 minutes.

Evening Each RGC will prepare a Draft Review Report of the MMS Report Section under consideration. This will be presented at the first plenary session on 24 November.

24 November 1987

0800 Coffee and donuts. '

0830 Plenary session. Each RGC presents the Draft Review Report (approximately 20 minutes including questions and comments from the panelists) of the MMS/OCS Report Sections prepared the previous evening.

- If the panelists accept the Draft Review Report, then the report goes to final draft.
- If there is disagreement, then the RGC will convene during the afternoon to resolve any conflicts.

Noon -1330 Lunch: Room 127A/B, Wood Center.

1330-1420 Review Groups meet to resolve conflicts.

1420-1530 Plenary session. Review Group Coordinators present revised draft reports (5 minutes) followed by brief comment/discussion (5 minutes), if any, from panelists.

- If the panelists accept the revised review, then it is prepared as a final draft.
- If there is still conflict concerning the revised review, the RGC will note this in preparing the final draft. This does not apply to RG-7 (Integration).

1530-1715 Plenary session. The Review Group Coordinator for RG-7 (Integration) continues the review in plenary session.

1715-1730 The RGC for RG-7 (Integration) presents the review, notes any conflict, and prepares the final draft.

1730-1800 Plenary session. Overview of the two-day panel meeting -J. Kelley and J. Burns. Final comments-J. Kelley.

1800 Each RGC presents written final draft reviews of each Report Section to the Chairman, Science Advisory Committee.

The draft final report of this task (SAC-OR-109) will be prepared and mailed to each RGC on or about November 30, 1987. Any comment or suggested changes should be given to the chairman, Science Advisory Committee, by phone or telemail on or before December 4, 1987. A final report will be sent to the North Slope Borough by December 10, 1987.

JJK/gt

Enclosures

APPENDIX 2- REVIEW GROUP COORDINATORS (RGC)

Report Section (RS)	Review Group Coordinator (RGC)
1. Water Masses	John Kelley
2. Zooplankton/Hydro acoustics	Ted Cooney
3. Distribution, Numbers, Activities	John Burns
4. Feeding/Isotopes	Patrick Parker
5. Energetic	Lloyd Lowry
6. Radio Telemetry	Erich Follmann
7. Integration	John Kelley

APPENDIX 3- REVIEW GROUPS

(M) - Mail Review Comment

Report Section (RS)	Review Group Participants
1. Water Masses	John Kelley (RGC) John Goering Gary Hufford
2. Zooplankton/Hydroacoustics	Ted Cooney (RGC) John Kelley John Goering Michael Macaulay (M) Ian McLaren (M)
3. Distribution, Numbers, Activities	John Burns (RGC) Lloyd Lowry Byron Morris Erich Follmann Dana Thomas Don Ljungblad
4. Feeding/Isotopes	Patrick Parker (RGC) John Burns Lloyd Lowry Stephen MacLean
5. Energetic	Lloyd Lowry (RGC) Robert Elsner Stephen MacLean Ian McLaren (M)
6. Radio Telemetry	Erich Follmann (RGC) John Burns Lloyd Lowry Don Ljungblad
7. Integration - Conclusions	John Kelley (RGC) All panelists

SCIENCE ADVISORY COMMITTEE REVIEW POLICY

Reviews of proposals, reports and scientific and technical documents are carried out by the NSB Science Advisory Committee by request of the Mayor, North Slope Borough or the Mayor's designee. Reviews are performed by either mail, panel discussions, or a combination of both. Reviewers whose professional backgrounds are appropriate to the document under consideration are chosen from the membership of the Science Advisory Committee. Additional reviewers who have particular expertise pertinent to the document under review are also solicited.

A coordinator is designated to receive the results of the reviews and to produce a summary of the expressed opinion. An overall qualitative rating of the document is given if requested. At the conclusion of the task the coordinator sends a report of the review to the Mayor, North Slope Borough. This report contains a description of the task, summary, individual (unsigned) review forms (if requested), and a list of participants. Signed original review forms, when such forms are required, are sent to the North Slope Borough. All communication concerning the results of the review are made through the Office of the Mayor, North Slope Borough.

SCIENCE ADVISORY COMMITTEE: OVERVIEW

The Science Advisory Committee (SAC) operates under authority of the Mayor of the North Slope Borough (NSB). It provides advisory and review services of a scientific and technological nature upon request of the Mayor or his designee.

The Science Advisory Committee was established in October 1980 to assist the Alaska Eskimo Whaling Commission (AEWC) by providing technical advice and proposal review services for its bowhead whale research program. The SAC was composed of a small standing committee and a larger corresponding group which varied in size according to need.

Services requested of the Science Advisory Committee steadily broadened to include environmental and technical problems of interest to the North Slope Borough that were not necessarily related to the bowhead whale. The North Slope Borough sought advice on a diverse range of problems associated with the rapid pace of oil exploration and developmental activities going on within its boundaries.

In 1982 a formal agreement between the Alaska Eskimo Whaling Commission and the North Slope Borough was made through a memorandum of understanding which specified that the NSB would be responsible for science matters as they relate to the bowhead whale.

In view of this agreement between the NSB and the AEWC as well as the above mentioned broadening scope of requests made upon the SAC it was felt that the relationship between the NSB and the SAC should be more properly defined. On November 30, 1982 the Mayor, North Slope Borough, announced that the SAC would be referred to as the North Slope Borough Science Advisory Committee.

Mission of the Science Advisory Committee

When requested by the Mayor of the North Slope Borough, the Science Advisory Committee will:

1. Advise the North Slope Borough on the scope and structure of research programs needed to evaluate and/or mitigate environmental impacts associated with resource development within the Borough.
2. Provide peer review for research proposals and research results as pertains to studies supported by the North Slope Borough.
3. Provide peer review of studies (research proposals and results) supported by others that may affect the North Slope Borough.
4. Provide peer review of various technical documents whose findings and/or interpretations may affect the North Slope Borough.

Structure of the Science Advisory Committee

In order to accomplish its mission the Science Advisory Committee is composed of individuals who collectively possess a wide range of expertise.

Membership on the Committee is of three types, namely: standing members, corresponding members, and *ex officio* members.

The standing members are called upon most frequently. However, corresponding members and even outside consultants are included in Committee deliberations as deemed appropriate by the Chairman.

When Committee action is required, the Mayor of the North Slope Borough makes a specific request to the Science Advisory Committee Chairman. The Chairman then selects the appropriate members of the Committee to participate in the requested activity. Upon completion of the requested task, the Committee's findings are sent by the Chairman to the Mayor.